

19 BUNDESREPUBLIK
DEUTSCHLAND



DEUTSCHES
PATENT- UND
MARKENAMT

12 **Offenlegungsschrift**
10 **DE 198 03 591 A 1**

51 Int. Cl.⁶:
D 21 F 1/00
D 21 F 9/02

21 Aktenzeichen: 198 03 591.8
22 Anmeldetag: 30. 1. 98
43 Offenlegungstag: 5. 8. 99

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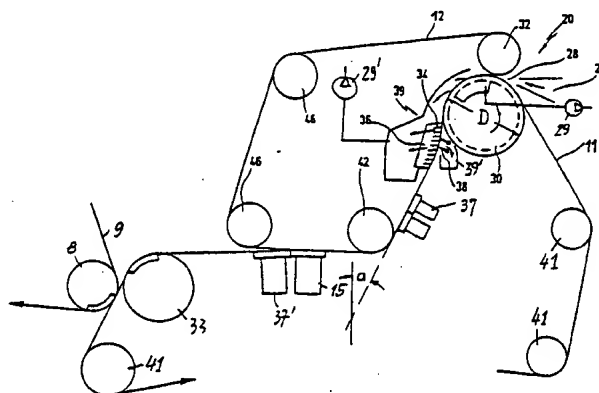
55 Für die Beurteilung der Patentfähigkeit in Betracht
zu ziehende Druckschriften:

DE 32 22 428 C2
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DE 82 05 443 U1
DE 77 02 891 U1
US 49 25 531

Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

54 Doppelsieb-Former

57 Ein Doppelsieb-Former zur Herstellung einer Papierbahn aus einer Faserstoffsuspension hat zwei Siebbänder (Untersieb 11 und Obersieb 12), die miteinander eine Doppelsiebzone bilden. In einem ersten Abschnitt der Doppelsiebzone, in dem die beiden Siebbänder (11, 12) über eine Formierwalze (30) laufen, bilden die beiden Siebbänder unmittelbar an der Formierwalze miteinander einen keilförmigen Einlaufspalt (28), der unmittelbar von einem Stoffauflauf (26) die Faserstoffsuspension aufnimmt. In einem zweiten Abschnitt der Doppelsiebzone laufen die beiden Siebbänder (11, 12) mit der dazwischen sich bildenden Faserstoffbahn über weitere Entwässerungselemente (36, 37). Wesentlich ist, daß die Doppelsiebzone unmittelbar ausgehend von der Formierwalze (30) steil nach unten verläuft.



DE 198 03 591 A 1

DE 198 03 591 A 1

Beschreibung

Die Erfindung betrifft einen Doppelsieb-Former zur Herstellung einer Faserstoffbahn, insbesondere Papierbahn, aus einer Faserstoffsuspension.

Zum Stand der Technik wird auf die folgenden Druckschriften verwiesen:

D1, EP 0489094 (PA 046138),

D2, Fachzeitschrift "Das Papier" 1970, Heft 10A, Seiten 779 bis 784,

D3, DE 43 01 103 (PA 05055),

D4, DE 43 28 997 (PA 05179),

D5, DE 197 33 316, noch nicht veröffentlicht (PA 10569),

D6, DE 197 20 258, noch nicht veröffentlicht (PA 10534).

Die Erfindung geht aus vom Gegenstand der Druckschrift D1. Daraus ist bekannt ein Doppelsieb-Former mit zwei Siebbändern, die miteinander eine Doppelsiebzone bilden. Am Beginn dieser Doppelsiebzone bilden die zwei Siebbänder miteinander einen keilförmigen Einlaufspalt, der unmittelbar von einem Stoffauflauf die Faserstoffsuspension aufnimmt. Es handelt sich also um einen sogenannten Gap-Former. Unmittelbar am keilförmigen Einlaufspalt laufen die zwei Siebe über eine drehbare Formierwalze. In Sieblaufrichtung hinter dieser Formierwalze kommen die beiden Siebbänder innerhalb der Doppelsiebzone im wesentlichen nur noch mit Formierleisten und/oder Formierschuhen in Kontakt.

Bei einigen Bauformen des bekannten Doppelsieb-Formers verlaufen die beiden Siebe innerhalb der Doppelsiebzone im wesentlichen in horizontaler Richtung oder schräg ansteigend. Deshalb benötigen die in der Schlaufe des Obersiebes befindlichen Entwässerungseinrichtungen zum Abführen des Wassers relativ hohen Unterdruck. Bei einer anderen Bauform verlaufen die beiden Siebbänder im wesentlichen senkrecht von unten nach oben, und zwar am Einlaufspalt zunächst über eine Formierwalze, die in der Regel als Saugwalze ausgebildet ist. In den oberhalb der Formierwalze befindlichen Entwässerungskästen sind zum Abführen des Wassers zumindest einige Umlenkflächen erforderlich, dazu u. U. wiederum ein Unterdruck-Anschluß.

Doppelsieb-Former der Bauart gemäß Druckschrift D1 haben sich in der Praxis bewährt insbesondere in der Variante mit einer unmittelbar am Einlaufspalt angeordneten Formierwalze. Aufgrund des Vorhandenseins dieser Formierwalze werden die beiden Siebe unmittelbar hinter dem Einlaufspalt am Umfang der Formierwalze über einen relativ scharf gekrümmten Weg geführt, denn der Mantel der Formierwalze hat einen relativ kleinen Krümmungsradius, verglichen mit dem großen Krümmungsradius eines am Einlaufspalt angeordneten Formierschuhs. Wenn nun der aus dem Stoffauflauf kommende Suspensionsstrahl in den keilförmigen Einlaufspalt eintritt, so strömt ein relativ großer Anteil des Suspensionswassers nahezu geradlinig durch das Obersieb hindurch. Dabei löst sich der Wasserstrahl rasch und über die Maschinenbreite gleichmäßig vom Obersieb. Dieser Umstand trägt wesentlich zu einer raschen und insbesondere gleichmäßigen Bahnbildung bei. Mit anderen Worten: Man erzielt eine hohe Qualität der fertigen Faserstoffbahn trotz einer raschen Bahnbildung bei einer kompakten, kostengünstigen Bauweise des Formers.

Ein weiterer Vorteil einer am Anfang der Doppelsiebzone befindlichen Formierwalze besteht im folgenden: Nicht nur das Untersieb, sondern auch das Obersieb ist bekanntlich in Längsrichtung gespannt und wird mit dieser Längsspannung beim Lauf über die Formierwalze umgelenkt. Hierdurch wird der Gefahr vorgebeugt, daß sich sogenannte Siebröhren bilden, die sich in Laufrichtung erstrecken. Mit anderen Worten: Das Obersieb wird speziell in dem kritischen An-

fangsbereich der Bahnbildung auch in Querrichtung straff gehalten, was wiederum zur gleichmäßigen Bahnbildung beiträgt. Insbesondere wird eine sogenannte Längsstreifigkeit in der Papierbahn vermieden.

Ein Nachteil der aus der Druckschrift D1 bekannten Doppelsieb-Former besteht darin, daß im Betrieb für das Bereitstellen von Unterdruck relativ viel Energie verbraucht wird. Außerdem ist das Anfahren des Formers manchmal schwierig, wenn es zu einem sogenannten Wasserstau kommt. Deshalb liegt der vorliegenden Erfindung die Aufgabe zugrunde, den bekannten Doppelsieb-Former dahingehend weiter zu entwickeln, daß die Entwässerungselemente der Doppelsiebzone mit geringeren Unterdrücken als bisher betrieben werden können und daß gleichzeitig mit möglichst geringem Aufwand ein stabiler Betriebszustand hergestellt und im Dauerbetrieb beibehalten werden kann.

Diese Aufgabe wird gemäß Anspruch 1 dadurch gelöst, daß – unter Beibehaltung der unmittelbar am keilförmigen Einlaufspalt befindlichen Formierwalze – die Doppelsiebzone steil nach unten verläuft. Dadurch erfolgt das Abführen eines relativ großen Teiles des die Siebe durchdringenden Suspensionswassers allein unter der Schwerkraft oder zumindest mit wesentlicher Unterstützung durch die Schwerkraft. Der Mantel der Formierwalze hat wie bisher Ausnehmungen zum vorübergehenden Speichern von Wasser. Dabei ist wesentlich, daß das gespeicherte Wasser in Richtung nach unten aus dem Mantel der Formierwalze abgeschleudert wird. Somit braucht die Formierwalze in manchen Fällen (z. B. bei relativ geringer Arbeitsgeschwindigkeit) nicht als Saugwalze ausgebildet zu sein. Die Regel wird jedoch sein, daß die Formierwalze eine Saugwalze ist, aber man wird sie mit geringerem Unterdruck als bisher betreiben können.

Auch in den auf die Formierwalze folgenden Entwässerungselementen ist die Höhe des Unterdrucks (wenn dieser überhaupt notwendig ist) geringer als bisher, dank der Wasserableitung (wie schon erwähnt) mit Unterstützung durch die Schwerkraft. Dieser Umstand erleichtert auch das Anfahren des Formers und das Herbeiführen eines stabilen Betriebszustandes (ohne Gefahr eines Wasserstaus).

Die hohe Anordnung des Stoffauflaufes vermindert die Gefahr von Rückströmungen (besonders wichtig für niedrige Geschwindigkeiten). Außerdem liegt der Stoffauflauf dadurch in einem sauberen Bereich mit guter Zugänglichkeit und guten Umgebungsbedingungen für Steuerungselemente, z. B. für die Ventile zur sektionierten Verdünnungswasserzugabe zwecks Einstellung des gewünschten Flächengewichts-Querprofils der fertigen Papierbahn. Ebenso liegt die Formierwalze in einer günstigeren Position als bisher, so daß sie in einfacher Weise mit dem Kran ein- oder ausgebaut werden kann.

Wie bisher findet schon im Bereich der Formierwalze ein Abführen sehr großer Wassermengen durch beide Siebe hindurch statt; d. h. die Bahnbildung erfolgt schon im Anfangsbereich der Doppelsiebzone sehr rasch und trotzdem sehr gleichmäßig. Unter Umständen ist es sogar möglich, den Anteil der im Bereich der Formierwalze abgeführten Wassermengen noch zu steigern. Dementsprechend verringern sich die im Bereich der nachfolgenden stationären Entwässerungselemente (z. B. Leisten) abzuführenden Wassermengen. Dadurch und durch den induzierten Vakuum Einsatz: werden bessere Festigkeitseigenschaften, insbes. Berstdruck erwartet.

Das neue Design eignet sich hervorragend für den Umbau von Langsiebpartien, da die Höhe des existierenden Langsiebes nicht relevant ist. Beim bisherigen Design konnte der Stoffauflauf oft nur schwer untergebracht werden.

Aus der Druckschrift D2 ist zwar schon ein Doppelsieb-

Former mit steil nach unten verlaufender Doppelsiebzone bekannt. Dort ist jedoch vor einer von beiden Sieben umschlungenen Formierwalze ein von beiden Sieben umschlungener konvex gekrümmter Formierschuh vorgesehen.

Weitere Ausgestaltungen der Erfindung sind in den Unteransprüchen und in den nachfolgenden Figurenbeschreibung angegeben. Jede der Fig. 1 bis 6 zeigt schematisch einen Doppelsieb-Former in Seitenansicht.

Der in Fig. 1 dargestellte Doppelsieb-Former umfaßt zwei Siebbänder, nämlich ein Obersieb 11 und ein Untersieb 12. Diese bilden, ausgehend von einer Formierwalze 30, eine Doppelsiebzone. Bevor das Obersieb 12 am Umfang der Formierwalze 30 mit dem Untersieb 11 in Kontakt kommt, läuft es über eine Brustwalze 32. Zwischen den beiden Walzen 30 und 32 bilden die beiden Siebbänder 11 und 12 miteinander einen keilförmigen Einlaufspalt 28, der unmittelbar von einem Stoffauflauf 26 eine Faserstoffsuspension aufnimmt. Der Stoffauflauf 26 ist nur schematisch angedeutet. Vorzugsweise handelt es sich um einen Stoffauflauf, der in bekannter Weise mit einer sektioniert steuerbaren Verdünnungswasserzugabe ausgerüstet ist, zwecks Einstellung eines gewünschten Flächengewichts-Querprofils der fertigen Papierbahn.

Der insgesamt mit 20 bezeichnete Doppelsieb-Former hat innerhalb der Schlaufe des Obersiebes 12 im Bereich der Formierwalze 30 eine Wasser-Auffangeinrichtung 39. Dorthin gelangt zunächst ein großer Teil des Suspensionswassers, welches am Beginn der Doppelsiebzone das Obersieb 12 durchdringt. Dies erfolgt im wesentlichen im oberen absteigenden Quadranten der Formierwalze 30. Ungefähr auf der Höhe der Formierwalzen-Drehachse laufen die beiden Siebe 11 und 12 mit der sich dazwischen bildenden Faserstoffbahn nach unten von der Formierwalze ab. Sie laufen sodann über einen in der Schlaufe des Obersiebes 12 angeordneten, konvex gekrümmten Formierschuh 36, der mit einer Vielzahl von Leisten 34 am Obersieb 12 anliegt. Zwischen den Leisten 34 dringt weiteres Suspensionswasser in die Auffangwanne 39. Ein weiterer Teil des Suspensionswassers strömt durch das Untersieb 11 in eine Auffangwanne 39'. Hier können Formierleisten 38 vorgesehen sein, die in bekannter Weise nachgiebig an das Untersieb 11 andrückbar sind. Anstelle dieser Formierleisten kann im Bereich des Formierschuhs 36 – gemäß Fig. 2 – dem Untersieb 11 wenigstens ein Deflektor 40 zugeordnet sein.

Der Mantel der Formierwalze 30 hat in bekannter Weise Ausnehmungen zum vorübergehenden Speichern von Wasser, z. B. in Form eines Wabenbezuges und eines darauf befestigten Siebstrumpfes. Zusätzlich kann, falls erforderlich, die Formierwalze 30 als Saugwalze ausgebildet sein. Dies gilt für alle Ausführungsbeispiele. Dargestellt ist eine Saug-einrichtung jedoch nur in den Fig. 1 und 6, Ziffer 29. Auch die in der Schlaufe des Obersiebes 12 angeordnete Wasser-auffangeinrichtung 39 sowie der Formierschuh 36 können bei Bedarf an eine Unterdruck-Quelle 29' angeschlossen sein.

Allen Ausführungsbeispielen ist gemeinsam, daß in der Doppelsiebzone die beiden Siebe 11 und 12, unmittelbar ausgehend von der Formierwalze 30, steil nach unten laufen. In diesem Bereich bildet die Doppelsiebzone mit einer gedachten Vertikalebene einen Winkel α , der zwischen 10 und 50 Grad beträgt, wobei in diesem Abschnitt das Obersieb 12 sich stets oberhalb des Untersiebes 11 befindet. Vorzugsweise ist der Winkel α kleiner als 45 Grad. In dem steil nach unten laufenden Abschnitt der Doppelsiebzone können noch weitere Entwässerungselemente vorgesehen sein, z. B. das Untersieb 11 berührende Saugkästen 37.

Bei den Ausführungsbeispielen gemäß Fig. 1 bis 3 und 6 ist am Ende des steil nach unten verlaufenden Abschnittes

der Doppelsiebzone eine Umlenkwalze 42 vorgesehen, welche die beiden Siebbänder 11, 12 in eine im wesentlichen horizontale Laufrichtung umlenkt. Hier ist in der Schlaufe des Untersiebes 11 ein Trennsauger 15 vorgesehen, an dem das Obersieb 12 sich vom Untersieb und von der darauf befindlichen Papierbahn abhebt. Das Obersieb 12 läuft von hier über Leitwalzen 46 zurück zur Brustwalze 32. Das Untersieb 11 läuft nach dem Trennsauger 15 – falls erforderlich über wenigstens einen weiteren Saugkasten 37' – zu einer Siebsaugwalze 33, danach über Leitwalzen 41 zurück zur Formierwalze 30. Unmittelbar hinter der Siebsaugwalze 33 wird die gebildete Papierbahn in bekannter Weise mittels eines Filzes 9 und einer Abnahmewalze 8 vom Untersieb 11 abgenommen.

In den Fig. 1 und 4 bis 6 ist die Ausströmrichtung des Stoffauflaufes 26 nahezu horizontal oder – wie dargestellt – geringfügig nach oben ansteigend. Die letztere Anordnung hat den Vorteil, daß sich der Stoffauflauf bei einem vorübergehenden Stillstand der Papiermaschine nicht leer läuft, so daß er sich während des Stillstandes nicht durch Abkühlung verformt. Entsprechend der Anordnung des Stoffauflaufes 26 gemäß den Fig. 1 und 4 bis 6 umschlingt das Obersieb 12 ungefähr den ganzen oberen absteigenden Quadranten der Formierwalze 30. Abweichend hiervon ist in den Fig. 2 und 3 eine kleinere Umschlingungszone des Obersiebes 12 auf der Formierwalze 30 vorgesehen. Dementsprechend ist die Ausströmrichtung des Stoffauflaufes 26' schräg von oben nach unten gerichtet. Falls man die Lage des Einlaufspaltes 28 von Zeit zu Zeit ändern will, können der Stoffauflauf 26' und die Brustwalze 32' um die Drehachse der Formierwalze 30 verschwenkt werden wie in Fig. 2 mit einem Doppelpfeil 25 angedeutet ist; siehe hierzu Druckschrift D4.

Für einige Ausführungsbeispiele gilt, daß – wie in den Fig. 2 und 3 dargestellt – am Umfang der Formierwalze 30 wenigstens eine nachgiebig an das Obersieb 12 andrückbare Formierleiste 27 vorgesehen sein kann, wie bekannt aus der eingangs genannten Druckschrift D3.

Eine Besonderheit des Ausführungsbeispiels gemäß Fig. 3 besteht darin, daß in dem steil nach unten verlaufenden Abschnitt der Doppelsiebzone Gleichdruck-Entwässerungselemente 16, 17 vorgesehen sind; dies sind vorzugsweise perforierte Platten oder Plattensegmente. Das eine Gleichdruck-Entwässerungselement 16 ist Teil eines stationären (und evtl. besaugten Entwässerungskastens) und liegt beispielsweise am Obersieb 12 an. Das gegenüberliegende Gleichdruck-Entwässerungselement 17 ruht mit Hilfe von Pneumatikschläuchen 14 auf einem weiteren stationären Kasten; es ist hierdurch mittels einer wählbaren Kraft nachgiebig an das Untersieb 11 anstellbar. Gleichdruck-Entwässerungselemente dieser Art sind Gegenstand der eingangs unter D5 genannten Patentanmeldung; auch in dem ungefähr horizontalen Teil der Doppelsiebzone können solche Elemente angeordnet sein. Gemäß Fig. 6 ist zwischen der Formierwalze 30 und den Elementen 16/17 eine (vorzugsweise perforierte) konvex gekrümmte Führungsplatte 14 an das Obersieb 14 angelegt, um zu vermeiden, daß sich in einer geraden Sieblaufstrecke die Siebe vorübergehend voneinander lösen.

Eine Besonderheit des Ausführungsbeispiels gemäß Fig. 4 besteht darin, daß innerhalb der Doppelsiebzone die beiden Siebbänder 11, 12 außer der Formierwalze 30 nur mit stationären Entwässerungselementen in Kontakt kommen, nämlich mit dem Formierschuh 36, falls erforderlich mit den Formierleisten 38 und einem Saugkasten 37. Auf den letzteren folgt ein stationärer Trennsauger 25. Von hier wird das Obersieb 12 über die Leitwalze 42' nach oben zurückgeführt. Nach dem Trennsauger 25 läuft das Untersieb 11 weiterhin steil nach unten, vorzugsweise über weitere Saugkä-

sten 37', wonach die Papierbahn mittels Filz 9 und Abnahmewalze 8 vom Untersieb 11 abgenommen wird.

Eine andere Variante ist in Fig. 5 dargestellt. Hier ist am Ende des steil nach unten verlaufenden Abschnittes der Doppelsiebzone in der Schlaufe des Obersiebes 12 eine Siebsaugwalze 35 vorgesehen, über welche beide Siebe 11 und 12 mit der dazwischen befindlichen Papierbahn laufen. Die Siebsaugwalze 35 besitzt eine Trennsaugzone, an der das Untersieb 11 von der Papierbahn und dem Obersieb 12 getrennt wird. Somit wird in diesem Fall die Papierbahn (mittels Filz 9 und Abnahmewalze 8) vom Obersieb 12 abgenommen.

Für alle Ausführungsbeispiele gilt, daß die Formierwalze 30 einen relativ großen Durchmesser D aufweist. Dieser kann beispielsweise zwischen 1,5 und 2,5 m betragen. Zur seitlichen Abdichtung des Einlaufspaltes 28 können Dichtelemente gemäß der eingangs unter D6 genannten Patentanmeldung vorgesehen sein.

Die gemäß den Fig. 1-3 und 6 von beiden Siebbändern 11, 12 gemeinsam umschlungene Leitwalze 42 stellt sicher, daß keine bzw. nur geringe lokale Differenzgeschwindigkeiten der Siebe auftreten. Die "S"-förmige Bahnführung wird somit als nicht kritisch eingestuft. Die Bahn ist bis in den Bereich des Formierschuhs 36 bzw. der Elemente 16/17 in der Mitte noch flüssig. Daher können in diesem Bereich keine bzw. nur sehr geringe Kräfte zwischen den Sieben übertragen werden; kleine lokale Differenzgeschwindigkeiten sind also zulässig. Verschleiß an den Siebrändern und ein negativer Einfluß auf die Festigkeitseigenschaften der fertigen Papierbahn werden dank der "S"-förmigen Bahnführung vollkommen oder zumindest weitgehend vermieden.

Die dargestellten Ausführungsbeispiele können wie folgt abgewandelt werden: Wenigstens eine der an das Untersieb 11 nachgiebig andrückbaren Formierleisten 38 (z. B. Fig. 1) und/oder wenigstens eine der an das Obersieb 12 nachgiebig andrückbaren Formierleisten 27 (z. B. Fig. 2) kann ersetzt werden durch eine sogen. Formier-Wasserdüse gemäß der am gleichen Tag eingereichten Patentanmeldung 198 ... (PA 10658).

Die wesentliche Besonderheit der Fig. 6 besteht darin, daß die gesamte Bahnbildung ohne Leisten stattfindet, also ohne das Einleiten von Druckpulsationen in die Fasersuspension. Mit anderen Worten: Es sind nur Gleichdruck-Entwässerungselemente vorhanden nämlich die Formierwalze 30 (vorzugsweise als Saugwalze), die Führungsplatte 14 und die anhand der Fig. 3 beschriebenen Elemente 16 und 17. Dadurch verbleibt ein höherer Anteil der Fein- und Füllstoffe in der gebildeten Papierbahn.

Die dargestellten Ausführungsbeispiele, insbesondere dasjenige gemäß Fig. 6, können wie folgt abgewandelt werden:

Man plaziert am Ende des steil nach unten verlaufenden Abschnittes der Doppelsiebzone in der Schlaufe des Obersiebes 12 einen Trennsauger, um das Untersieb 11 von der Bahn zu trennen. Diese läuft mit dem Obersieb über die Umlenkwalze 42, welche die Bahn mit einer (zuvor auf z. B. einem Langsieb gebildeten) anderen Bahn zusammenhaut. In diesem Fall dient somit der erfindungsgemäße Doppelsieb-Former zum Bilden einer Lage einer mehrlagigen Papier- oder Kartonbahn.

Patentansprüche

1. Doppelsieb-Former zur Herstellung einer Faserstoffbahn, insbesondere Papierbahn, aus einer Faserstoffsuspension, mit den folgenden Merkmalen:

a) zwei Siebbänder (Untersieb 11 und Obersieb

12) bilden miteinander eine Doppelsiebzone;

b) in einem ersten Abschnitt der Doppelsiebzone, in dem die beiden Siebbänder (11, 12) über ein Entwässerungselement in Form einer rotierenden Formierwalze (30) laufen, bilden die beiden Siebbänder unmittelbar an der Formierwalze miteinander einen keilförmigen Einlaufspalt (28), der unmittelbar von einem Stoffauflauf (26) die Faserstoffsuspension aufnimmt ("Gap-Former");

c) in einem zweiten Abschnitt der Doppelsiebzone laufen die beiden Siebbänder (11, 12) mit der dazwischen sich bildenden Faserstoffbahn über weitere Entwässerungselemente (36, 37 oder 16, 17);

d) am Ende der Doppelsiebzone laufen die Siebbänder über eine Trenneinrichtung (15, 25, 35), die eines der Siebbänder von der gebildeten Faserstoffbahn und dem anderen Siebband trennt;

e) dadurch gekennzeichnet, daß die Doppelsiebzone, wie an sich bekannt, unmittelbar ausgehend von der Formierwalze (30) steil nach unten verläuft.

2. Doppelsieb-Former nach Anspruch 1, dadurch gekennzeichnet, daß der steil nach unten verlaufende zweite Abschnitt der Doppelsiebzone mit einer gedachten Vertikalebene einen Winkel (a) einschließt, der zwischen 10 und 50 Grad beträgt vorzugsweise ist der Winkel (a) kleiner als 45 Grad.

3. Doppelsieb-Former nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß eine Umlenkeinrichtung (42) die beiden Siebbänder (11, 12), wie an sich bekannt, aus dem steil nach unten führenden Laufweg in einen im wesentlichen horizontalen oder leicht ansteigenden Abschnitt umlenkt.

4. Doppelsieb-Former nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Größe des Umschlingungswinkels des Obersiebes (12) an der Formierwalze (30) in an sich bekannter Weise veränderbar ist durch Verschwenken des Stoffauflaufes (26') und der das Obersieb (12) zur Formierwalze führenden Brustwalze (32') um die Drehachse der Formierwalze (Doppelpfeil 25, Fig. 2).

5. Doppelsieb-Former nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß in dem steil nach unten verlaufenden Abschnitt der Doppelsiebzone ein am Obersieb (12) anliegender konvex gekrümmter Formierschuh (36) vorgesehen ist.

6. Doppelsieb-Former nach Anspruch 5, dadurch gekennzeichnet, daß im Bereich des Formierschuhs (36) dem Untersieb (11) wenigstens ein Deflektor (40) zugeordnet ist.

7. Doppelsieb-Former nach Anspruch 5, dadurch gekennzeichnet, daß im Bereich des Formierschuhs (36) wenigstens eine nachgiebig an das Untersieb (11) andrückbare Formierleiste (38) vorgesehen ist.

8. Doppelsieb-Former nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß am Umfang der Formierwalze (30) wenigstens eine nachgiebig an das Obersieb (12) andrückbare Formierleiste (27) vorgesehen ist.

9. Doppelsieb-Former nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß in dem steil nach unten verlaufenden Abschnitt der Doppelsiebzone sogenannte Gleichdruck-Entwässerungselemente (16, 17) vorgesehen sind, wobei ein stationäres Gleichdruck-Entwässerungselement (16) an dem einen Siebband (12) anliegt und wenigstens ein gegenüberliegendes Gleichdruck-Entwässerungselement (17) mittels

einer wählbaren Kraft nachgiebig an das andere Siebband (11) anstellbar ist (Fig. 3).

10. Doppelsieb-Former nach Anspruch 9, dadurch gekennzeichnet, daß die Gleichdruck-Entwässerungselemente (16, 17) als Platten oder als Plattensegmente 5 ausgebildet sind.

11. Doppelsieb-Former nach Anspruch 9 oder 10, dadurch gekennzeichnet, daß die Gleichdruck-Entwässerungselemente (16, 17) fluiddurchlässig, vorzugsweise perforiert sind. 10

12. Doppelsieb-Former nach Anspruch 1, dadurch gekennzeichnet, daß innerhalb der Doppelsiebzone die beiden Siebbänder (11, 12) außer der Formierwalze (30) nur mit stationären Entwässerungselementen (36, 37) in Kontakt kommen, wobei die Trenneinrichtung 15 (25) als ein stationärer Trennsauger ausgebildet ist, der in dem steil nach unten verlaufenden Abschnitt der Doppelsiebzone am Untersieb (11) anliegt (Fig. 4).

13. Doppelsieb-Former nach Anspruch 12, dadurch gekennzeichnet, daß das Untersieb (11) nach der 20 Trenneinrichtung weiterhin steil nach unten läuft, vorzugsweise über weitere stationäre Entwässerungselemente (37'), wonach die gebildete Faserstoffbahn, wie an sich bekannt mittels einer Abnahmeeinrichtung (8, 9) vom Untersieb (11) abgenommen wird. 25

14. Doppelsieb-Former nach Anspruch 1, dadurch gekennzeichnet, daß am Ende des steil nach unten verlaufenden Abschnittes der Doppelsiebzone die beiden Siebbänder (11, 12) über eine in der Schlaufe des Obersiebes (12) befindliche Siebsaugwalze (35) geführt 30 sind; diese besitzt eine Trennsaugzone, an der das Untersieb (11) von der Faserstoffbahn und dem Obersieb (12) getrennt wird (Fig. 5).

15. Doppelsieb-Former nach Anspruch 1, dadurch gekennzeichnet, daß er frei von Formationsleisten ist 35 (Fig. 6).

16. Doppelsieb-Former nach den Ansprüchen 9 und 15, dadurch gekennzeichnet, daß die Siebbänder (11, 12) unmittelbar nach der Formierwalze (30) über eine 40 am Obersieb (12) anliegende (vorzugsweise perforierte) konvex gekrümmte Führungsplatte (14) laufen (Fig. 6).

Hierzu 6 Seite(n) Zeichnungen

45

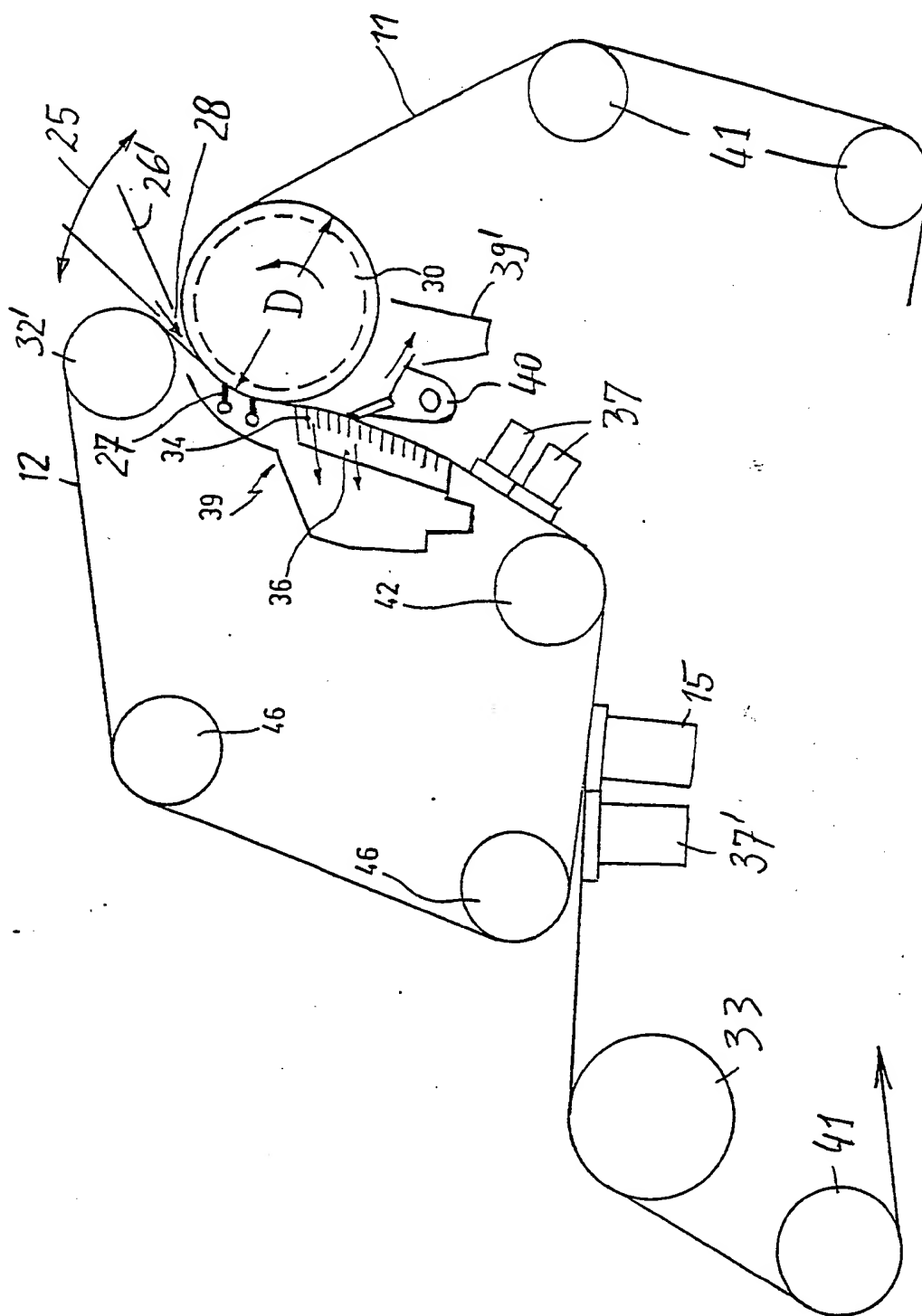
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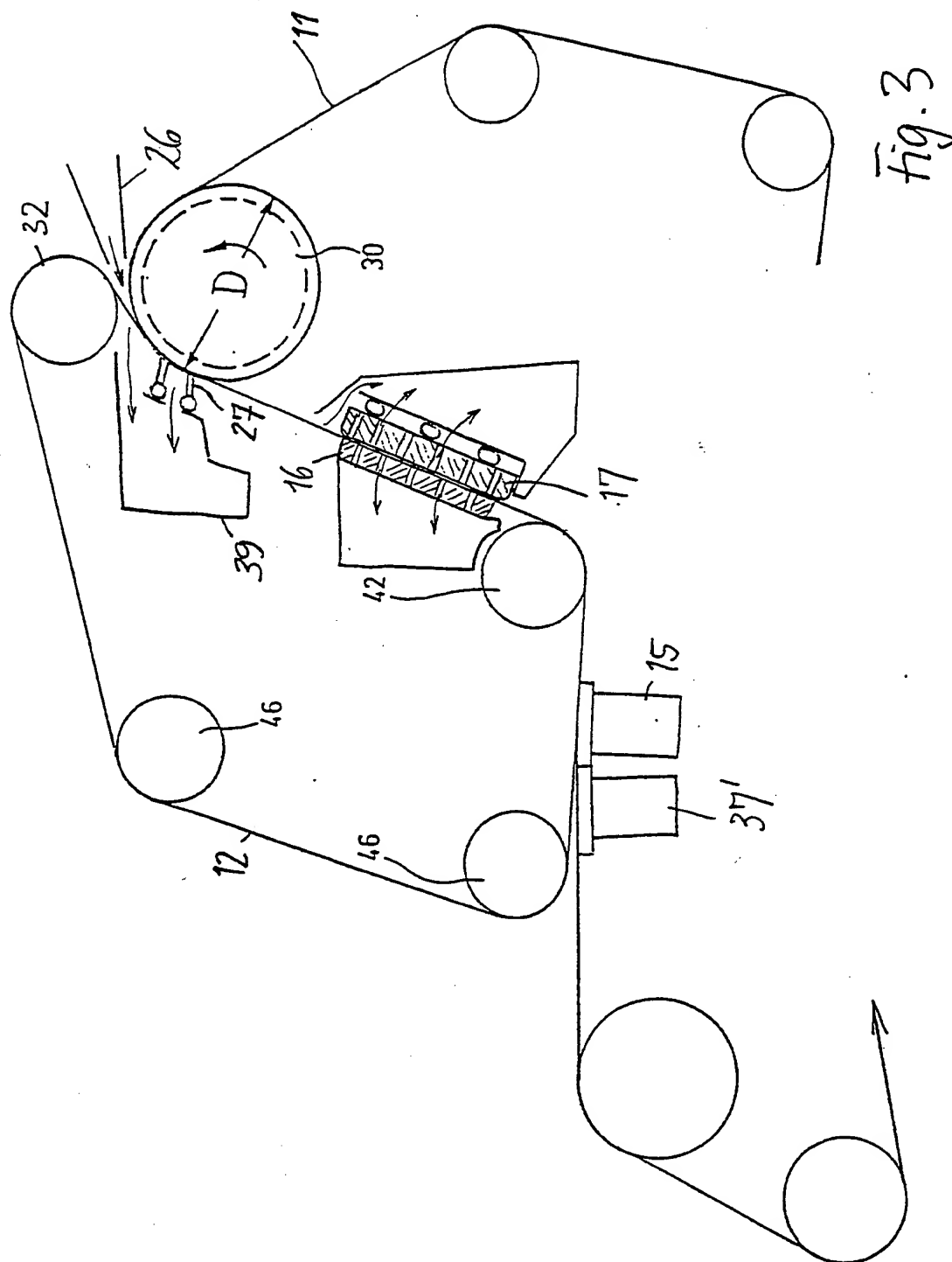


Fig. 4

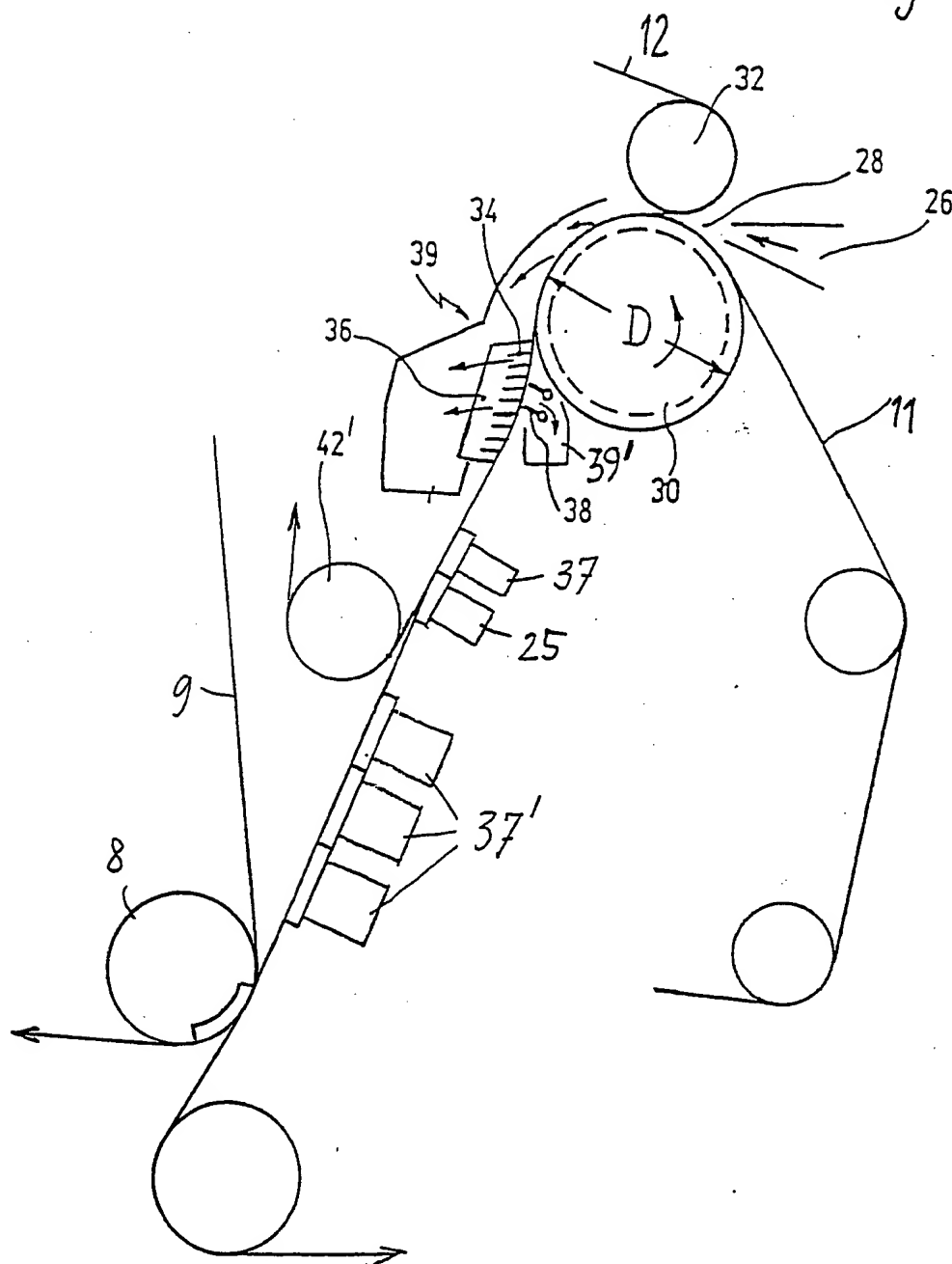
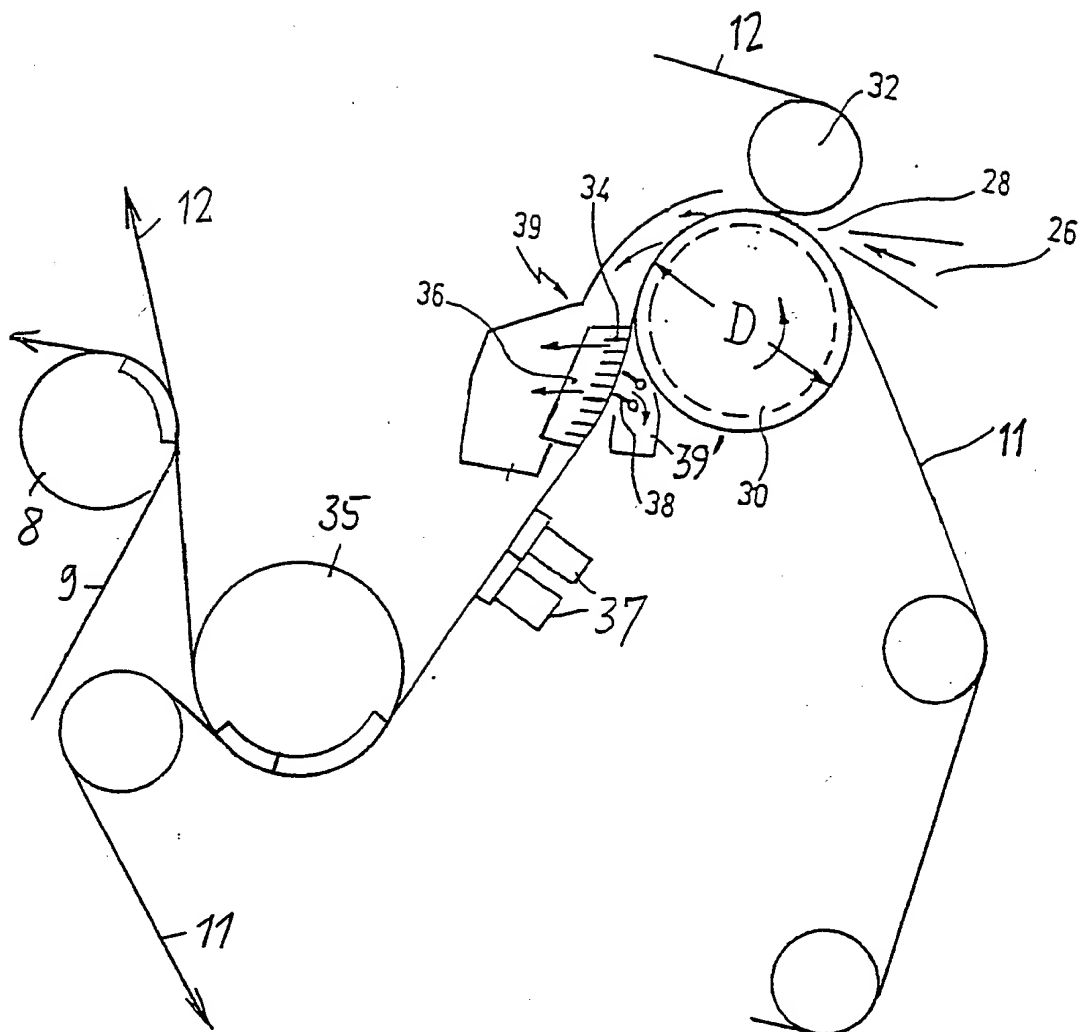
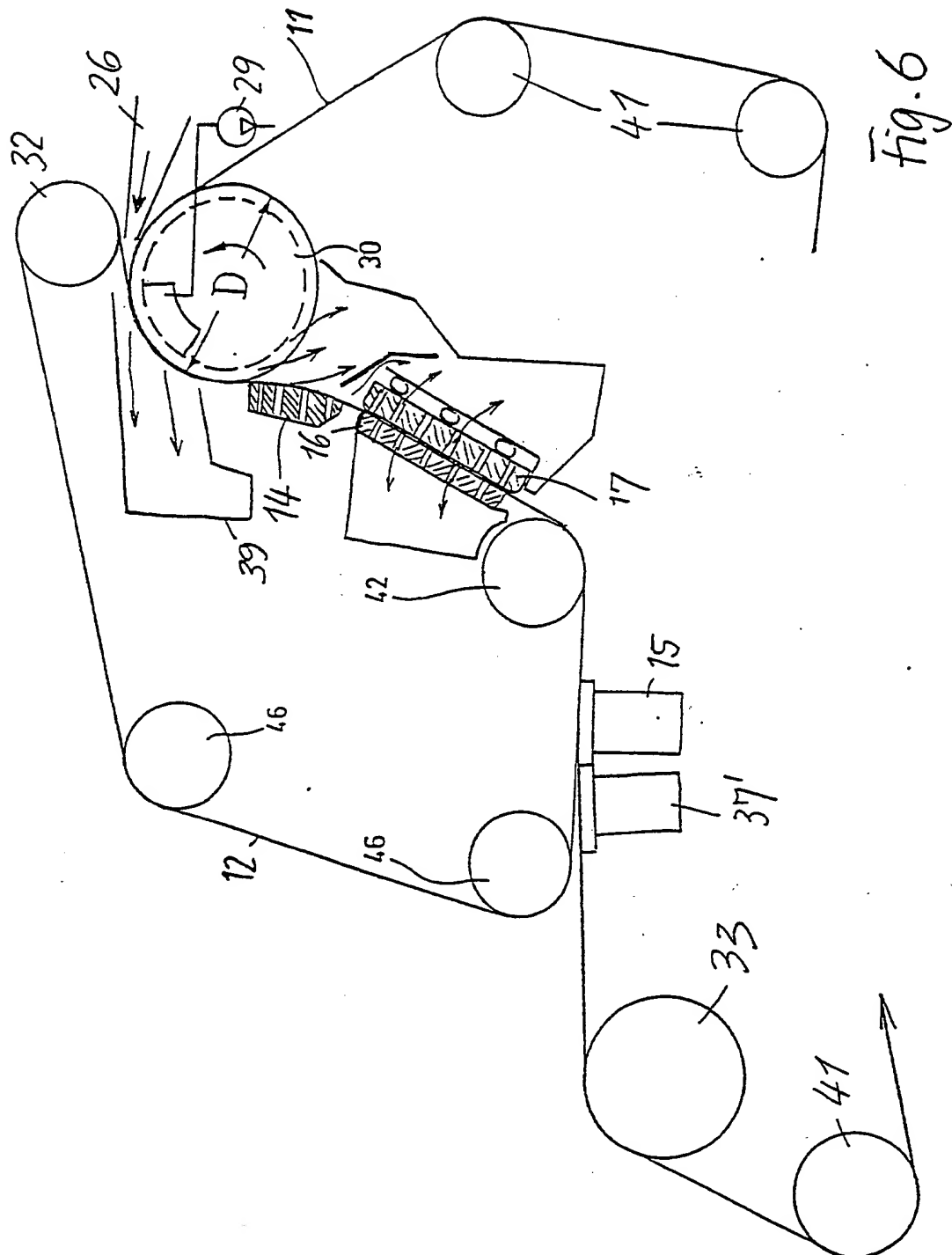


Fig. 5





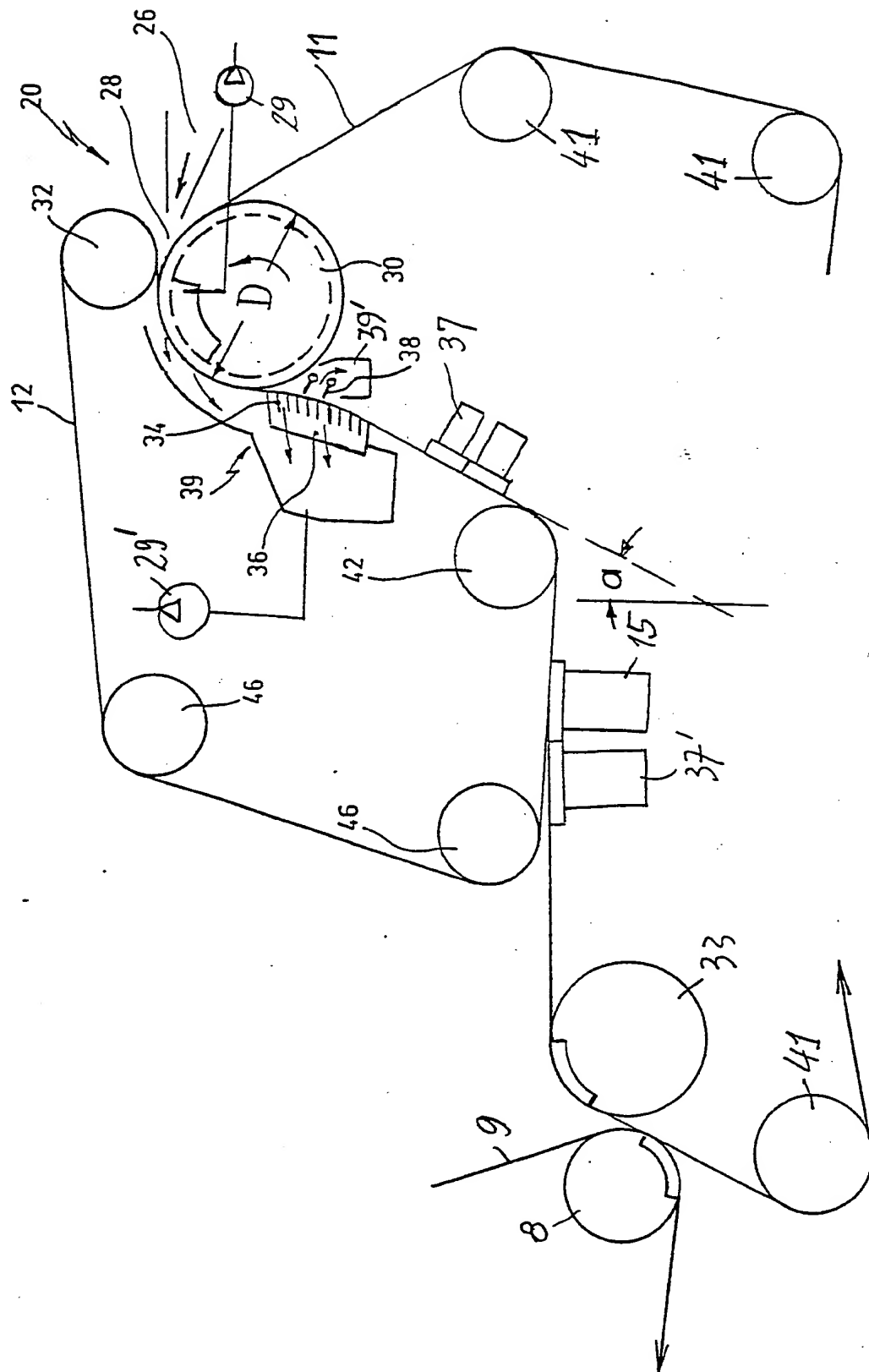


Fig. 1

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APPLICATION NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTORNEY DOCKET NO.	DRWGS	TOT CL	IND CL
09/237,842	01/27/99	3725	\$1,532.00	P17245	6	34	8

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FOREIGN APPLICATIONS- DEF REP GERMANY 1 198 03 591.8 01/30/98

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TWIN WIRE FORMER AND METHOD OF MANUFACTURING A FIBROUS MATERIAL WEB
FROM A FIBROUS SUSPENSION USING SAME

PRELIMINARY CLASS: 140

DATA ENTRY BY: ARMSTEAD, LORRAINE TEAM: 06 DATE: 04/08/99

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

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COPY

TITLE OF THE INVENTION

TWIN WIRE FORMER AND METHOD OF MANUFACTURING A FIBROUS
MATERIAL WEB FROM A FIBROUS SUSPENSION USING SAME

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P17245.S02

TWIN WIRE FORMER AND METHOD OF MANUFACTURING A FIBROUS
MATERIAL WEB FROM A FIBROUS SUSPENSION USING SAME

5

CROSS-REFERENCE TO RELATED APPLICATIONS

10

The present application claims priority under 35 U.S.C. § 119 of German Patent Application No. 198 03 591.8, filed on January 30, 1998, the disclosure of which is expressly incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

15

1. Field of the Invention

The invention relates to a twin wire former and method of manufacturing a fibrous material web with a twin wire former, and more particularly, to a twin wire former and method for manufacturing a fibrous material web, such as a paper web, from a fibrous suspension.

20

2. Discussion of Background Information

25

Twin wire formers are known in related art apparatus. One such apparatus is disclosed in European Patent No. EP 0489094. This document discloses a twin wire former with two wire belts, which jointly constitute a twin wire zone. At the beginning of the twin wire zone, the two wire belts jointly form a wedge-shaped inlet gap, which receives the fibrous suspension directly from a headbox. The two wire belts are thus known as a "gap former." Directly at the wedge-shaped inlet gap, the two wires travel by way of a rotatable forming roller. Downstream from the forming roller with respect to the rotational direction

thereof, the two wire belts contact forming strips and/or forming shoes inside the twin wire zone.

In other embodiments of twin wire formers, the two wires travel in a generally horizontal direction or ascend diagonally inside the twin wire zone. Consequently, the drainage devices disposed inside the perimeter of the upper wire require relatively high suction to remove the water. In other embodiments, the two wire belts travel in a generally vertical direction upward from the bottom, at the inlet gap. The belts travel by way of a forming roller, which is embodied as a suction roller. In drainage boxes disposed above the forming roller, a few deflection surfaces are necessary to remove the water, possibly requiring a suction connection.

Twin wire formers according to above-noted European Patent No. EP 0489094 may be useful, especially when a forming roller is disposed directly at the inlet gap. Because of the presence of this forming roller, the two wires are guided along a sharply curved path about the circumference of the forming roller immediately downstream of the inlet gap. This sharply curved path is required because the sleeve of the forming roller has a small radius in comparison with the large radius of a forming shoe disposed at the inlet gap. When the suspension stream coming out of the headbox enters the wedge-shaped inlet gap, a large portion of the suspension flows almost in a straight line through the top wire. From the top wire, the water stream breaks up rapidly and uniformly over the width of the machine. Rapid and uniform breakup of the water stream contributes to rapid and uniform web formation. High quality finished fibrous material webs may be produced by this twin wire former, even though the web is rapidly formed.

The disposition of the forming roll at the beginning of the twin wire zone enables both the top wire and bottom wire to be stretched tautly, which creates longitudinal tension, thereby preventing the forming of wire tubes in the travel direction. Additionally, keeping the top wire taut in the lateral direction contributes to uniform web formation, particularly

in the critical beginning region of the web formation. Keeping the top wire taut in the lateral direction additionally helps prevent the defect known as "longitudinal striping" in the paper.

However, a disadvantage of the twin wire former known from the above reference EP 0489094 is that during operation, a large amount of energy is used for the production of suction. Furthermore, the starting up of this twin wire former is sometimes difficult when there is a backup of water in the machine.

The trade journal "Das Paper" [Paper] 1970, No. 10A, pp. 779 to 784, discloses a twin wire former with a twin wire zone that steeply travels in a downward direction. The convexly curved forming shoe that both wires wind around is provided before a forming roller around which both wires wind.

SUMMARY OF THE INVENTION

The present invention provides a twin wire former and method for manufacturing a fibrous material web from a fibrous suspension using a twin wire former. The device of the present invention comprises a movable bottom wire belt and a movable top wire belt converging at a twin wire zone. The twin wire zone has a first section, a second section and an end section. A rotating forming roller is disposed at the first section of the twin wire zone, the top wire and the bottom wire forming a wedge-shaped inlet gap at the first section of the twin wire zone, the inlet gap being adapted to receive the fibrous suspension from a headbox. The bottom wire belt and the top wire belt form the fibrous web therebetween at the second section of the twin wire zone, and the second section of the twin wire zone has at least one drainage element. The invention also comprises a separating device adapted to separate one wire belt from the other wire belt. The twin wire zone has a section disposed in a steep downward direction downstream of the forming roller in relation to the movement of the wire belts.

The steep downward direction of the twin wire zone may be an angle between about 10 and 50 degrees from the vertical, and is preferably between about 10 and 45 degrees from the vertical.

5 The twin wire former may also include a deflection device for deflecting the bottom wire belt and the top wire belt from the steep downward direction section, to a generally horizontal direction.

10 In another aspect of the invention, the invention may also comprise a breast roller disposed upstream from the forming roller in relation to the movement of the top wire, the breast roller being adapted to guide the top wire. The breast roller and the headbox together may then be pivoted about a rotational axis of the forming roller.

15 Furthermore, the invention may comprise a convexly curved forming shoe disposed against the top wire at the steep downward direction section of the twin wire zone. At least one deflector disposed against the bottom wire may be provided opposite the forming shoe. The invention may further comprise at least one forming strip flexibly disposed against the bottom wire, opposite the forming shoe.

A further aspect of the invention may provide at least one forming strip flexibly disposed against the top wire at the circumference of the forming roller.

20 According to another aspect of the invention a first and a second constant-pressure drainage element (which may be fluid permeable and/or perforated) at the steep downward direction section of the twin wire zone may be provided, the first constant-pressure drainage element being stationary and disposed against the top wire belt. The second constant-pressure drainage element is flexibly disposed opposite the first constant-pressure drainage element against the second wire belt. These elements may be embodied as plates or plate segments.

25 A convexly curved guide plate, which may be perforated, may also be disposed alongside and downstream from the forming roller in relation to the movement of the wire belts, the top wire belt and the second wire belt being adapted to travel over the convexly curved guide plate, the convexly curved guide plate further resting against the top wire.

Additionally, inside the twin wire zone, the top wire belt and the bottom wire belt may be configured so that they only come into contact with the forming roller, the forming shoe and the suction device. The separating device may be a stationary separating suction device disposed against the bottom wire at the steep downward direction section of the twin wire zone.

Furthermore, at least one additional suction device may be provided at the steep downward direction section of the bottom wire, and a removal device adapted to remove the fibrous web material from the bottom wire at a point downstream from the at least one additional suction device may also be provided.

The top wire belt and the bottom wire belt may also be adapted to be conveyed by a wire suction roller at a point downstream from the steep downward direction section. The wire suction roller may be disposed against an inside perimeter of the top wire. The wire suction roller may also have a separating suction zone adapted for separating the fibrous material web and the top wire from the bottom wire.

The method of manufacturing a fibrous material web from a fibrous suspension using a twin wire former comprises the steps of depositing the fibrous suspension from a headbox into the inlet gap, draining fluid from the fibrous suspension through the rotating forming roller, forming a fibrous web between the first and second wire belts, draining fluid through the fibrous web through a drainage element, and separating one wire belt and the formed fibrous web material from the other wire belt.

The method may also comprise deflecting the two wire belts from the steep downward direction to a generally horizontal direction with a deflection device.

Additionally, the method may comprise guiding the top wire about a breast roller disposed upstream from the forming roller in relation to the movement of the top wire, and adjusting the size of a winding angle of the top wire by pivoting the breast roller with the headbox, about a rotational axis of the forming roller.

Furthermore, the method may comprise using a convexly curved forming shoe to form the fibrous web between the first and second wire belts.

The method may additionally comprise forming the fibrous web between the first and second wire belts with a forming strip.

5 The method may yet still comprise forming the fibrous web between the first and second wire belts with a constant-pressure drainage element at the steep downward direction section.

Other exemplary embodiments and advantages of the present invention may be ascertained by reviewing the present disclosure and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

15 The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of certain embodiments of the present invention, in which like numerals represent like elements throughout the several views of the drawings, and wherein:

Fig. 1 schematically shows a side schematic view of a twin wire former according to a first embodiment of the present invention.

20 Fig. 2 schematically shows a side schematic view of a twin wire former according to a second embodiment of the present invention.

Fig. 3 schematically shows a side schematic view of a twin wire former according to a third embodiment of the present invention.

Fig. 4 schematically shows a side schematic view of a twin wire former according to a fourth embodiment of the present invention.

25 Fig. 5 schematically shows a side schematic view of a twin wire former according to a fifth embodiment of the present invention.

Fig. 6 schematically shows a side schematic view of a twin wire former according to a sixth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

5 The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

10 The present invention allows drainage elements of a twin wire zone to be operated at lower energy cost and with less suction than related art inventions.

15 The twin wire zone travels steeply downward from a forming roller that is disposed directly at a wedge-shaped inlet gap. As a result, the removal of most of the suspension water passing through the twin wire zone takes place largely due to gravitational force. The sleeve of the forming roller has recesses for the temporary storage of water. The stored water is removed in the downward direction from the sleeve of the forming roller. Consequently, sometimes (e.g., with a relatively low operating speed) the forming roller need not be a suction roller. When using a suction roller, the suction roller may be operated with less suction than with art related twin wire formers.

20 The removal of most of the suspension water passing through the twin wire zone by gravitational force, allows less suctional force to be used in drainage elements downstream from the forming roller, than with art related twin wire formers. Alternatively, suction may not be necessary at all. Additionally, the removal of most of the suspension water passing through the twin wire zone by gravitational force, facilitates the starting up of the twin wire former and reduces the danger of the backing-up of water.

25 A headbox is disposed at an elevated position in relation to the twin wire zone, to reduce the danger of backflows, which is particularly important for operation at low speeds.

Furthermore, the headbox is positioned so that control elements are easily accessible by a user, e.g., the valves for the addition of dilution water may be more easily accessed. Similarly, the forming roller is disposed so that it can be simply installed or removed with a crane.

5 Large quantities of water are removed at the two wire belts in the region of the forming roller. Web formation occurs at the beginning of the twin wire zone in a rapid and uniform manner. Increasing the quantities of water removed at the region of the forming roller is further possible, thereby reducing quantities of water removed at the region of the subsequent stationary drainage elements (e.g., strips). By increasing the quantities of water
10 removed at the region of the forming roller and by reducing use of suction, stronger webs may be produced.

Referring now to the drawings wherein like numerals represent like elements, the twin wire former represented in Fig. 1 includes two endless wire belts, namely a bottom wire 11 and a top wire 12. The wires 11, 12 are complete belts, although they are shown broken
15 in the Figs. for illustrative purposes. At a forming roller 30, these wires 11, 12 form a twin wire zone. The top wire 12 travels by way of a breast roller 32 upstream of contacting the bottom wire 11 at the circumference of the forming roller 30. The two wire belts 11 and 12 jointly form a wedge-shaped inlet gap 28 between the forming roller 30 and the breast roller 32, the inlet gap being present at a first section of the twin wire zone. The inlet gap receives
20 a fibrous suspension from a headbox 26, the headbox 26 being schematically indicated. The headbox is equipped with a device that provides for the sectional and controllable addition of dilution water for the purpose of adjusting the desired cross section of the finished paper web, the device being well known to those skilled in the art.

The twin wire former 20 has a water collecting device 39 inside the perimeter of the
25 top wire 12 at the region of the forming roller 30. A large part of the suspension water which passes through the top wire 12 at the beginning of the twin wire zone is transported to the water collecting device 39, which occurs at the upper left quadrant of the forming roller 30, in Fig. 1. At the general level of the rotational axis of the forming roller 30, the two wires

11, 12, together with the fibrous material web being formed therebetween, travel downward and away from the forming roller. Downstream of the forming roller 30 (at a second section), the wires 11, 12 travel along a convexly curved forming shoe 36, which is disposed against the top wire 12 on the inside perimeter of the top wire 12, the shoe having a plurality of drainage strips 34. Additional suspension water passes into the catch basin 39 between these drainage strips 34. Still more suspension water flows through the bottom wire 11 into a catch basin 39'. Bottom forming strips 38 may be provided here. The bottom forming strips 38 may be flexibly pressed against the bottom wire 11 in a manner known by those skilled in the art. Alternatively, as shown according to a second embodiment in Fig. 2, instead of bottom forming strips 38, at least one deflector 40 can be used with the bottom wire 11 in the region of the forming shoe 36.

The sleeve of the forming roller 30 has recesses for temporary storage of water, for example, a honeycomb cover (not shown) or a wire sock (not shown). While a suction device 29 is shown only in Figs. 1 and 6, the forming roller 30 may also be a suction roller in all embodiments of the invention. Additionally, the water collecting device 39 disposed inside the loop of the top wire 12 and the forming shoe 36 may be connected to a suction source 29' in all embodiments of the invention.

In preferred embodiments of the present invention, the two wires 11, 12 travel steeply downward in the twin wire zone downstream from the forming roller 30. In this region, the twin wire zone, together with an imaginary vertical plane, forms an angle α , which is between about 10 and 50 degrees. In this region, the top wire 12 is always disposed above the bottom wire 11. Angle α is preferably less than about 45 degrees. In the portion of the twin wire zone that travels steeply downwardly, drainage elements may be provided, such as suction devices 37 that touch the bottom wire 11. Examples of drainage elements are forming shoes 36, suction devices 37 and constant-pressure drainage elements 16, 17.

According to the embodiments of Figs. 1, 2, 3 and 6, a deflection device, e.g., a deflection roller 42 is provided at the end of the section of the twin wire zone that travels steeply downwardly. The deflection roller 42 deflects both wire belts 11, 12 into a generally

horizontal direction of travel. Inside the loop of the bottom wire 11, a separating suction device 15 is provided (at the end section of the twin wire zone), which lifts the top wire 12 up from the bottom wire and also from the paper web disposed thereon. Other examples of separating devices are stationary separating suction devices 25 and wire suction rollers 35.

5 The top wire 12 travels from the separating suction device 15 via guide rollers 46, and returns back to the breast roller 32. After the separating suction device 15, the bottom wire 11 travels by way of at least one additional suction device 37' to a wire suction roller 33 and then via guide rollers 41 back to the forming roller 30. However, in alternative embodiments, the additional suction device 37' need not be used. The formed paper web is

10 removed from the bottom wire 11 immediately downstream from the wire suction roller 33 by a removal device such as a felt band 9 and a removal roller 8, although it will be readily appreciable by those skilled in the art that other removal means may be employed in other embodiments..

In the embodiments according to Figs. 1, 4, 5 and 6, the outflow direction of the headbox 26 is almost horizontal or ascends slightly (as shown). In these embodiments, the

15 headbox need not run idle when there is a temporary stoppage of the paper making machine. Thus, there is no deformity due to cooling during the stoppage. According to the disposition of the headbox 26 in accordance with the embodiments of Figs. 1, 4, 5 and 6, the top wire 12 winds about the upper descending quadrant of the forming roller 30.

20 According to the embodiments shown in Figs. 2 and 3, a smaller winding zone of the top wire 12 on the forming roller 30 is provided. The outflow direction of headbox 26' is directed horizontally downwardly from the right of Figs. 2 and 3. To change the position of the inlet gap 28, the headbox 26' and breast roller 32' can be pivoted about the rotational axis of the forming roller 30, as indicated by double arrow 125 in Fig. 2, and as shown in German

25 Patent No. DE 4328997, which is expressly incorporated herein in its entirety.

As shown in Figs. 2 and 3, at least one flexible top forming strip 27 which can be flexibly pressed against the top wire 12, can be provided on the circumference of the forming

roller 30, as shown in German Patent No. DE 4301103, which is expressly incorporated by reference in its entirety.

According to the embodiment of Fig. 3, first and second constant-pressure drainage elements 16, 17 respectively, are provided at the section of the twin wire zone that travels steeply downwardly. The constant-pressure drainage elements 16, 17 are preferably perforated plates or plate segments. The first constant-pressure drainage element 16 is stationarily fixed on the inside of the perimeter of the top wire 12 and is part of a stationary drainage box and, for example, rests against the top wire 12. The stationary drainage box may be provided with suction, if necessary.

With the aid of pneumatic hoses, the second constant-pressure drainage element 17 flexibly rests on another stationary box, opposite the first constant-pressure drainage element 16, and can be flexibly placed against the bottom wire 11 by means known to those skilled in the art. Constant-pressure drainage elements 16, 17 of this kind are disclosed in German Patent Application No. DE 19733316, which is expressly incorporated by reference in its entirety. Constant-pressure drainage elements 16, 17 of this kind can also be disposed in the generally horizontal part of the twin wire zone. According to Fig. 6, a convexly curved guide plate 14 is placed against the inside of the perimeter of the top wire 12 between the forming roller 30 and the constant-pressure drainage elements 16, 17, in order to prevent the wires 11, 12 from temporarily separating from each other. In the preferred embodiment, the guide plate 14 is perforated, but it will be readily appreciable by those skilled in the art that non-perforated guide plates may be used in other embodiments.

According to the embodiment of Fig. 4, the two wires 11, 12 only come into contact with stationary drainage elements and the forming roller 30, when the two wires are inside the twin wire zone. Specifically, the two wires 11, 12 only contact the forming shoe 36, and if necessary, contact the bottom forming strips 38 and a suction device 37. The suction device 37 is followed by a stationary separating suction device 25. Downstream of the separating suction device 25, the top wire 12 is conveyed back upwardly by way of guide roller 42'. Downstream of the separating suction device 25, the bottom wire 11 travels steeply

downwardly, by way of additional suction devices 37', whereupon the paper web is removed from the bottom wire 11 by known means of a felt band 9 and a removal roller 8. In alternative embodiments, additional suction devices 37' need not be used.

5 According to the embodiment of Fig. 5, a wire suction roller 35 is provided at the end of the section of the twin wire zone that travels steeply downwardly, inside the perimeter of the top wire 12. Both wires 11, 12 travel together by way of this wire suction roller, with the paper web disposed between the two wires. The wire suction roller 35 has a separating suction zone which separates the paper web and the top wire 12 from the bottom wire 11. The paper web may then be removed from the top wire 12 by means of a felt band 9 and a
10 removal roller 8, or by other means known by those skilled in the art.

In all embodiments, the forming roller 30 has a relatively large diameter D. For example this diameter D is between about 1.5 and 2.5 meters. Sealing elements can be provided for laterally sealing the inlet gap 28, as disclosed in German Patent Application No. DE 19720258, which is expressly incorporated by reference in its entirety.

15 According to the embodiments of Figs. 1, 2, 3 and 6, the guide roller 42 which the two wire belts 11, 12 wind around together, ensures that there are no significant speed differentials between the two wires. Thus, the present invention employs "S"-shaped web routing. The web is still fluid in the center until the regions of the forming shoe 36 or the constant-pressure drainage elements 16, 17 are reached. Therefore, no forces or very slight
20 forces are transmitted between the wires in this region. Small speed differentials in this area are thus permitted. The "S"-shaped web routing prevents wear at the wire edges and further prevents negative influences on the strength of the finished paper web.

The present invention may also be modified by replacing at least one of the flexible bottom forming strips 38 (for example, as seen in Fig. 1) that can be flexibly pressed against
25 the bottom wire 11, with a forming water nozzle as disclosed in German Patent Application No. 198 _____, which is expressly incorporated by reference in its entirety. Similarly at least one of the top forming strips 27 (for example, as seen in Fig. 2) that can be

flexibly pressed against the top wire 12 can be replaced by a forming water nozzle, also as disclosed in German Patent Application No. 198_____.

5 According to the embodiment shown in Fig. 6, the entire web formation takes place without forming strips, i.e., without the introduction of pressure pulsations into the fibrous suspension. Only constant-pressure drainage elements 16, 17 are present. Specifically, web formation occurs by using the forming roller 30, the guide plate 14, and the constant-pressure drainage elements 16 and 17, as described in conjunction with the embodiment of Fig. 3. Consequently, a higher percentage of the fines and fillers remains in the paper web produced. In the preferred embodiment, the forming roller 30 is a suction roller, but it is readily appreciable by those skilled in the art that forming rollers according to alternative
10 embodiments may not employ a suction roller.

The embodiments shown above, particularly the embodiment according to Fig. 6, can be modified by placing a separating suction device at the end section of the twin wire zone that travels steeply downwardly, inside the perimeter of the top wire 12, in order to separate
15 the bottom wire 11 from the web. The web travels with the top wire by way of the deflection roller 42, which presses the web together with another previously-formed web. In such a case, the twin wire former according to the invention is consequently used to form a layer of a multi-layer paper or cardboard web.

It is noted that the foregoing examples have been provided merely for the purpose of
20 explanation and are in no way to be construed as limiting of the present invention. While the present invention has been described with reference to certain embodiments, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope
25 and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular means, materials and embodiments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present

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invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A twin wire former for manufacturing a fibrous material web from a fibrous suspension, the twin wire former comprising:

- a) a movable bottom wire belt and a movable top wire belt converging at a twin wire zone, the twin wire zone having a first section, a second section and an end section;
- b) a rotating forming roller disposed at said first section of said twin wire zone, said top wire and said bottom wire forming a wedge-shaped inlet gap at said first section of said twin wire zone, said inlet gap adapted to receive the fibrous suspension from a headbox, said twin wire zone having a section disposed in a steep downward direction downstream of said forming roller in relation to the movement of said wires;
- c) said bottom wire belt and said top wire belt adapted to form the fibrous web therebetween at said second section of said twin wire zone, and said second section of said twin wire zone having at least one drainage element; and
- d) a separating device adapted to separate one said wire belt from another said wire belt.

2. The twin wire former according to claim 1, wherein said steep downward direction is an angle between about 10 and 50 degrees from the vertical.

3. The twin wire former according to claim 2, wherein said steep downward direction is an angle between about 10 and 45 degrees from the vertical.

4. The twin wire former according to claim 1, further comprising a deflection device adapted to deflect said bottom wire belt and said top wire belt from said steep downward direction section, to a generally horizontal direction.

5. The twin wire former according to claim 1, further comprising a breast roller disposed upstream from said forming roller in relation to the movement of said top wire, said breast roller adapted to guide said top wire, and said breast roller and said headbox together being adapted to pivot about a rotational axis of said forming roller.

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6. The twin wire former according to claim 1, further comprising a convexly curved forming shoe disposed against said top wire at said steep downward direction section of said twin wire zone.

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7. The twin wire former according to claim 6, further comprising at least one deflector disposed against said bottom wire, opposite said forming shoe.

8. The twin wire former according to claim 6, further comprising at least one forming strip flexibly disposed against said bottom wire, opposite said forming shoe.

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9. The twin wire former according to claim 1, wherein said forming roller has a circumference, the twin wire former further comprising at least one forming strip flexibly disposed against said top wire at said circumference of said forming roller.

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10. The twin wire former according to claim 1, further comprising a first and a second constant-pressure drainage element at said steep downward direction section of said twin wire zone, said first constant-pressure drainage element being stationary and disposed against said top wire belt, said second constant-pressure drainage element flexibly disposed opposite said first constant-pressure drainage element against said second wire belt.

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11. The twin wire former according to claim 10, further comprising a convexly curved guide plate disposed alongside and downstream from said forming roller in relation to the movement of said wires, said top wire belt and said second wire belt being adapted to

travel over said convexly curved guide plate, said convexly curved guide plate further resting against said top wire.

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12. The twin wire former according to claim 11, wherein said convexly curved guide plates are perforated.

13. The twin wire former according to claim 10, wherein said first and said second constant-pressure drainage elements are each plates.

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14. The twin wire former according to claim 10, wherein said first and said second constant-pressure drainage elements are each plate segments.

15. The twin wire former according to claim 10, wherein said first and said second constant-pressure drainage elements are fluid-permeable.

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16. The twin wire former according to claim 10, wherein said first and said second constant-pressure drainage elements are perforated.

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17. The twin wire former according to claim 1, wherein inside said twin wire zone, said top wire belt and said bottom wire belt only come into contact with said forming roller, said forming shoe and said suction device, and wherein said separating device is a stationary separating suction device, said stationary separating suction device disposed against said bottom wire at said steep downward direction section of said twin wire zone.

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18. The twin wire former according to claim 17, wherein said bottom wire is adapted to travel in a steep downward direction at a section downstream of said separating device in relation to the movement of said bottom wire, the twin wire former further comprising:

at least one additional suction device disposed at said steep downward direction section of said bottom wire; and

a removal device adapted to remove the fibrous web material from said bottom wire at a point downstream from said at least one additional suction device.

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19. The twin wire former according to claim 1, said top wire belt and said bottom wire belt being adapted to be conveyed by a wire suction roller at a point downstream from said steep downward direction section, in relation to the movement of said wires, said wire suction roller disposed against an inside perimeter of said top wire, said wire suction roller having a separating suction zone adapted for separating the fibrous material web and said top wire from said from said bottom wire.

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20. The twin wire former according to claim 1, wherein the former is free of forming strips.

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21. A twin wire former for manufacturing a fibrous material web from a fibrous suspension, the twin wire former comprising:

- a) a movable bottom wire belt and a movable top wire belt converging at a twin wire zone, the twin wire zone having a first section, a second section and a generally horizontal end section;
- b) a rotating forming roller disposed at said first section of said twin wire zone, said top wire and said bottom wire forming a wedge-shaped inlet gap at said first section of said twin wire zone, said inlet gap adapted to receive the fibrous suspension, said twin wire zone having a section disposed in a steep downward direction downstream of said forming roller in relation to the movement of said wires;
- c) a breast roller disposed upstream from said forming roller in relation to the movement of said top wire, said breast roller adapted to guide said top wire;

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- d) said bottom wire belt and said top wire belt adapted to form the fibrous web therebetween at said second section of said twin wire zone, and said second section of said twin wire zone having at least one forming shoe and at least one suction device;
- 5 e) at least one forming strip disposed against said bottom wire, opposite said forming shoe;
- f) a separating suction device adapted to separate one said wire belt from another said wire belt;
- g) at least one additional suction device disposed at said end section;
- 10 h) a removal device adapted to remove the fibrous web material from said bottom wire at a point downstream from said at least one additional suction device; and
- i) a deflection device adapted to deflect said bottom wire belt and said top wire belt from said steep downward direction section, to said generally horizontal end section.

15 22. The twin wire former according to claim 21, wherein said forming roller is a suction roller.

23. A twin wire former for manufacturing a fibrous material web from a fibrous suspension, the twin wire former comprising:

- 20 a) a movable bottom wire belt and a movable top wire belt converging at a twin wire zone, the twin wire zone having a first section, a second section and a generally horizontal end section;
- b) a rotating forming roller disposed at said first section of said twin wire zone, said top wire and said bottom wire forming a wedge-shaped inlet gap at said first section of
- 25 said twin wire zone, said inlet gap adapted to receive the fibrous suspension, said twin wire zone having a section disposed in a steep downward direction downstream of said forming roller in relation to the movement of said wires;

- c) a breast roller disposed upstream from said forming roller in relation to the movement of said top wire, said breast roller adapted to guide said top wire, and said breast roller and the headbox together being adapted to pivot about a rotational axis of said forming roller;
- 5 d) said bottom wire belt and said top wire belt adapted to form the fibrous web therebetween at said second section of said twin wire zone, and said second section of said twin wire zone having at least one forming shoe and at least one suction device;
- e) at least one deflector disposed against said bottom wire, opposite said forming shoe;
- 10 f) at least one forming strip flexibly disposed against said top wire at the circumference of said forming roller;
- g) a separating suction device adapted to separate one said wire belt from another said wire belt;
- h) at least one additional suction device disposed at said end section; and
- 15 i) a deflection device adapted to deflect said bottom wire belt and said top wire belt from said steep downward direction section, to said generally horizontal end section.

24. A twin wire former for manufacturing a fibrous material web from a fibrous suspension, the twin wire former comprising:

- 20 a) a movable bottom wire belt and a movable top wire belt converging at a twin wire zone, the twin wire zone having a first section, a second section and a generally horizontal end section;
- b) a rotating forming roller disposed at said first section of said twin wire zone, said top wire and said bottom wire forming a wedge-shaped inlet gap at said first section of
- 25 said twin wire zone, said inlet gap adapted to receive the fibrous suspension from a headbox, said twin wire zone having a section disposed in a steep downward direction downstream of said forming roller in relation to the movement of said wires;

- c) a breast roller disposed upstream from said forming roller in relation to the movement of said top wire, said breast roller adapted to guide said top wire;
 - d) said bottom wire belt and said top wire belt adapted to form the fibrous web therebetween at said second section of said twin wire zone, and said second section of said twin wire zone having a first and a second constant-pressure drainage element, said first constant-pressure drainage element being stationary and disposed against said top wire belt, said second constant-pressure drainage element flexibly disposed opposite said first constant-pressure drainage element against said second wire belt;
 - e) at least one forming strip flexibly disposed against said top wire at the circumference of said forming roller;
 - f) a separating suction device adapted to separate one said wire belt from another said wire belt;
 - g) a deflection device adapted to deflect said bottom wire belt and said top wire belt from said steep downward direction section, to said generally horizontal end section; and
 - h) at least one additional suction device disposed at said generally horizontal end section.
25. A twin wire former for manufacturing a fibrous material web from a fibrous suspension, the twin wire former comprising:
- a) a movable bottom wire belt and a movable top wire belt converging at a twin wire zone, the twin wire zone having a first section, a second section and an end section;
 - b) a rotating forming roller disposed at said first section of said twin wire zone, said top wire and said bottom wire forming a wedge-shaped inlet gap at said first section of said twin wire zone, said inlet gap adapted to receive the fibrous suspension, said second section and said end section of said twin wire zone being disposed in a steep

downward direction downstream of said forming roller in relation to the movement of said wires;

- c) a breast roller disposed upstream from said forming roller in relation to the movement of said top wire, said breast roller adapted to guide said top wire;
- 5 d) said bottom wire belt and said top wire belt adapted to form the fibrous web therebetween at said second section of said twin wire zone, and said second section of said twin wire zone having at least one forming shoe and at least one suction device;
- 10 e) at least one forming strip disposed against said bottom wire, opposite said forming shoe;
- f) a stationary separating suction device adapted to separate one said wire belt from another said wire belt;
- g) at least one additional suction device disposed downstream of said end section; and
- h) a removal device adapted to remove the fibrous web material from said bottom wire
- 15 at a point downstream from said at least one additional suction device.

26. A twin wire former for manufacturing a fibrous material web from a fibrous suspension, the twin wire former comprising:

- a) a movable bottom wire belt and a movable top wire belt converging at a twin wire zone, the twin wire zone having a first section, a second section and an end section;
- 20 b) a rotating forming roller disposed at said first section of said twin wire zone, said top wire and said bottom wire forming a wedge-shaped inlet gap at said first section of said twin wire zone, said inlet gap adapted to receive the fibrous suspension, said twin wire zone having a section disposed in a steep downward direction downstream
- 25 of said forming roller in relation to the movement of said wires
- c) a breast roller disposed upstream from said forming roller in relation to the movement of said top wire, said breast roller adapted to guide said top wire;

- d) said bottom wire belt and said top wire belt adapted to form the fibrous web therebetween at said second section of said twin wire zone, and said second section of said twin wire zone having at least one forming shoe and at least one suction device;
- 5 e) at least one forming strip disposed against said bottom wire, opposite said forming shoe;
- f) a wire suction roller adapted to separate one said wire belt from another said wire belt; and
- 10 g) a removal device adapted to remove the fibrous web material from said bottom wire at a point downstream from said at least one additional suction device.

27. A twin wire former for manufacturing a fibrous material web from a fibrous suspension, the twin wire former comprising:

- 15 a) a movable bottom wire belt and a movable top wire belt converging at a twin wire zone, the twin wire zone having a first section, a second section and a generally horizontal end section;
- b) a rotating forming roller disposed at said first section of said twin wire zone, said top wire and said bottom wire forming a wedge-shaped inlet gap at said first section of said twin wire zone, said inlet gap adapted to receive the fibrous suspension, said 20 twin wire zone having a section disposed in a steep downward direction downstream of said forming roller in relation to the movement of said wires;
- c) a breast roller disposed upstream from said forming roller in relation to the movement of said top wire, said breast roller adapted to guide said top wire;
- 25 d) a convexly curved forming shoe disposed alongside and downstream from said forming roller in relation to the movement of said wires, said top wire belt and said second wire belt being adapted to travel over said convexly curved guide plate, said convexly curved guide plate further resting against said top wire;

- 5 e) said bottom wire belt and said top wire belt downstream from said convexly curved forming shoe and adapted to form the fibrous web therebetween at said second section of said twin wire zone, and said second section of said twin wire zone having a first and a second constant-pressure drainage element, said first constant-pressure drainage element being stationary and disposed against said top wire belt, said second constant-pressure drainage element flexibly disposed opposite said first constant-pressure drainage element against said second wire belt;
- 10 f) a separating suction device adapted to separate one said wire belt from another said wire belt;
- g) at least one additional suction device disposed at said end section; and
- h) a deflection device adapted to deflect said bottom wire belt and said top wire belt from said steep downward direction section, to said generally horizontal end section.

15 28. The twin wire former according to claim 27, wherein said forming roller is a suction roller.

20 29. A method of manufacturing a fibrous material web from a fibrous suspension using a twin wire former, the twin wire former having movable top and bottom wire belts converging at a twin wire zone having a section disposed in a steep downward direction, the steep downward direction being an angle between about 10 and 50 degrees from the vertical, a rotating forming roller disposed at the first section, the first and second wire belts forming a wedge-shaped inlet gap at the first section of the twin wire zone, the twin wire former further having a headbox disposed in front of the first section of the twin wire zone, the method comprising:

- 25 a) depositing the fibrous suspension from a headbox into the inlet gap;
- b) draining fluid from the fibrous suspension through the rotating forming roller;
- c) forming a fibrous web between the first and second wire belts;
- d) draining fluid through the fibrous web through a drainage element; and

- e) separating one of the wire belts and the formed fibrous web material from the other of the wire belts.

5 30. The method of manufacturing a fibrous material web from a fibrous suspension using a twin wire former according to claim 29, the method further comprising deflecting the two wire belts from the steep downward direction to a generally horizontal direction with a deflection device.

10 31. The method of manufacturing a fibrous material web from a fibrous suspension using a twin wire former according to claim 28, the method further comprising:

guiding the top wire about a breast roller disposed upstream from the forming roller in relation to the movement of the top wire; and

adjusting the magnitude of a winding angle of the top wire by pivoting the breast roller together with the headbox, about a rotational axis of the forming roller.

15 32. The method of manufacturing a fibrous material web from a fibrous suspension using a twin wire former according to claim 29, the method further comprising forming the fibrous web between the first and second wire belts with a convexly curved forming shoe.

20 33. The method of manufacturing a fibrous material web from a fibrous suspension using a twin wire former according to claim 29, the method further comprising forming the fibrous web between the first and second wire belts with a forming strip.

25 34. The method of manufacturing a fibrous material web from a fibrous suspension using a twin wire former according to claim 29 further comprising forming the fibrous web between the first and second wire belts using a constant-pressure drainage element at the steep downward direction section.

ABSTRACT OF THE DISCLOSURE

5 Twin wire former and method for manufacturing a fibrous material web from a
fibrous suspension using same. The twin wire former comprises a movable bottom wire belt
and a movable top wire belt converging at a twin wire zone. The twin wire zone has a first
section, a second section and an end section. A rotating forming roller is disposed at the first
section of the twin wire zone, and the top wire and the bottom wire form a wedge-shaped
inlet gap at the first section of the twin wire zone. The inlet gap is adapted to receive the
fibrous suspension from a headbox. The bottom wire belt and the top wire belt are adapted
10 to form the fibrous web therebetween at the second section of the twin wire zone, and the
second section of the twin wire zone has at least one drainage element. A separating device
is disposed at the end of the twin wire zone and is adapted to separate one wire belt from
another the wire belt. The twin wire zone has a section disposed in a steep downward
direction downstream of the forming roller in relation to the movement of the wires. Also
15 disclosed is a method for manufacturing a fibrous material web from a fibrous suspension
using a twin wire former.

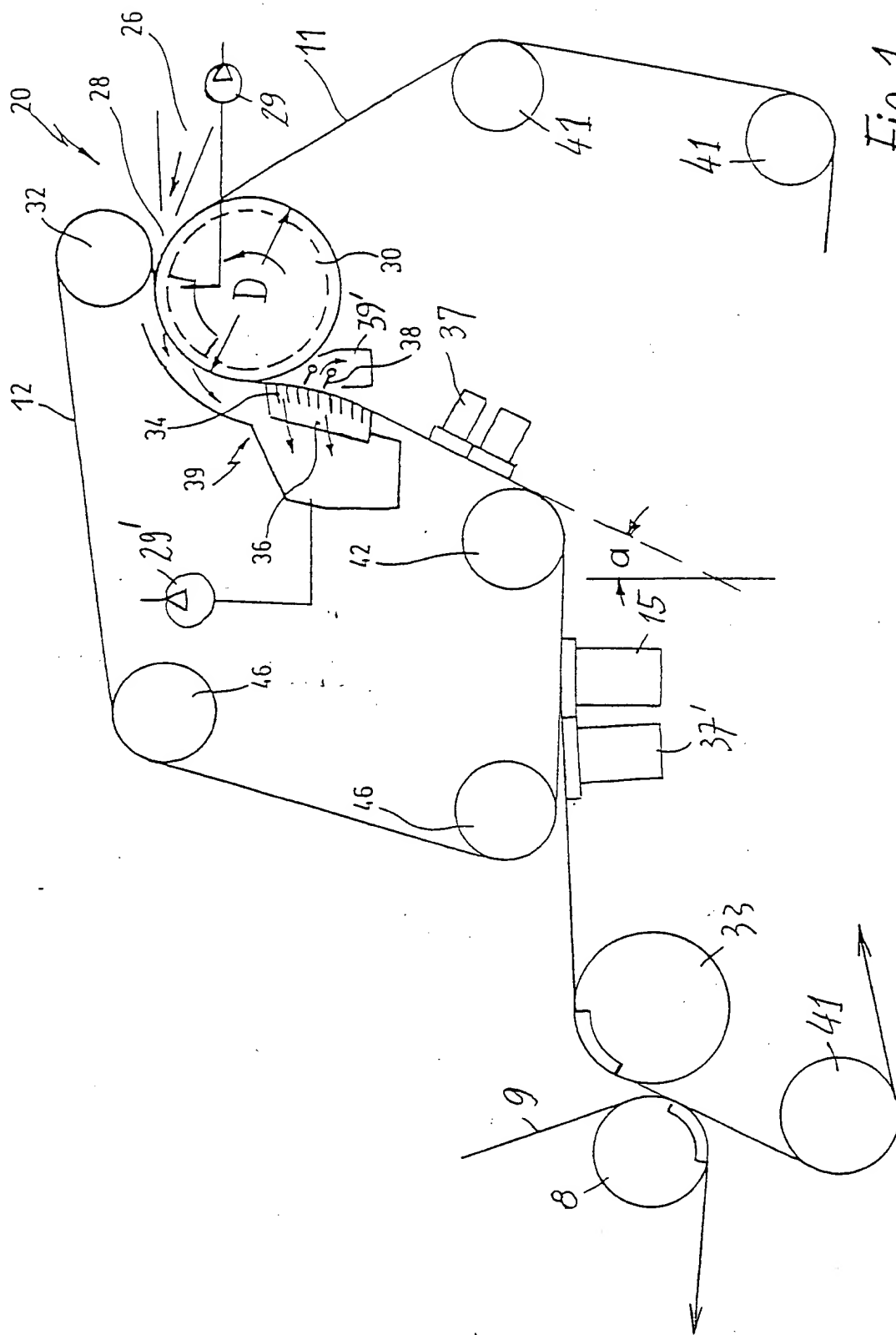


Fig. 1

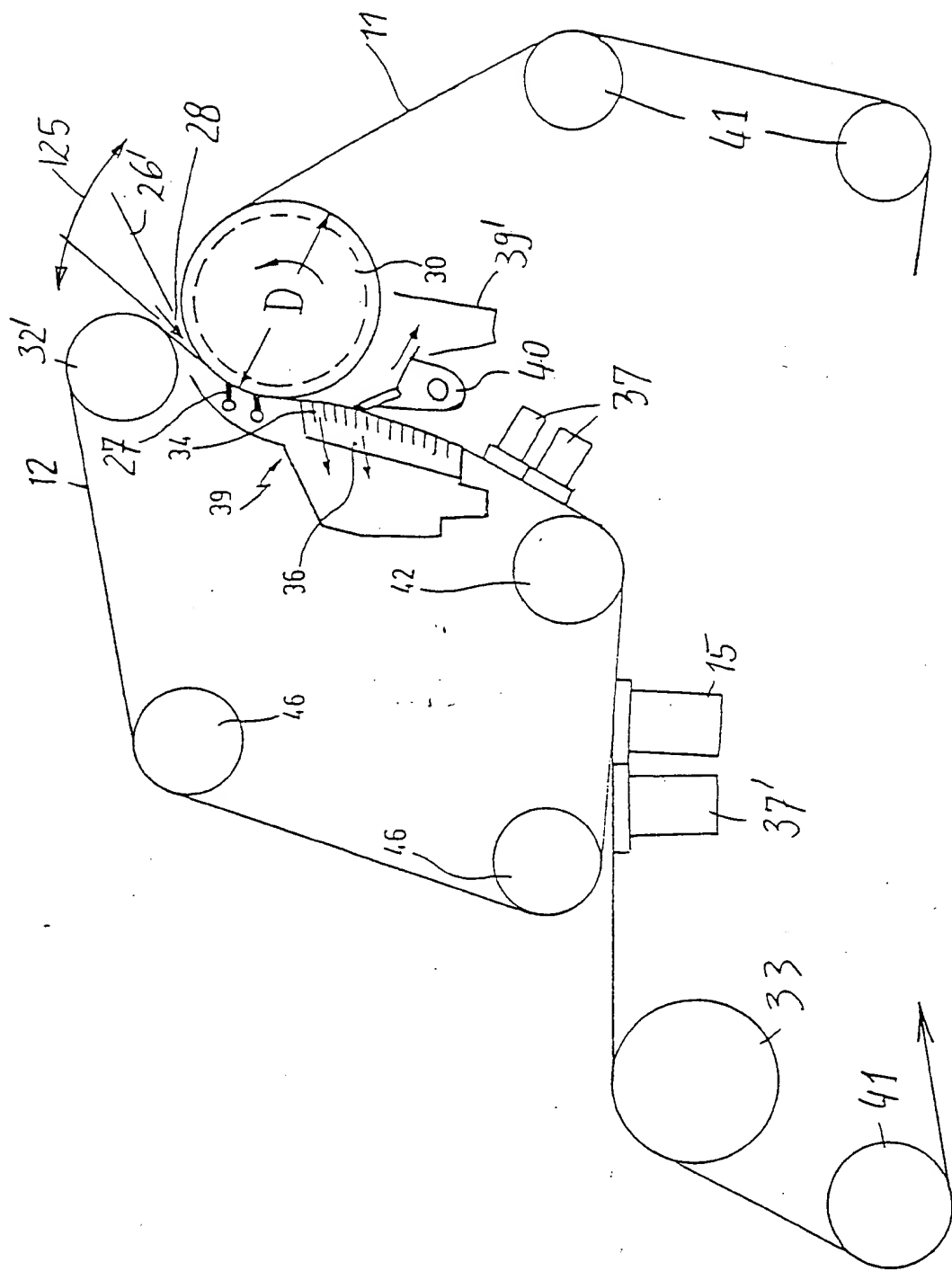


Fig. 2

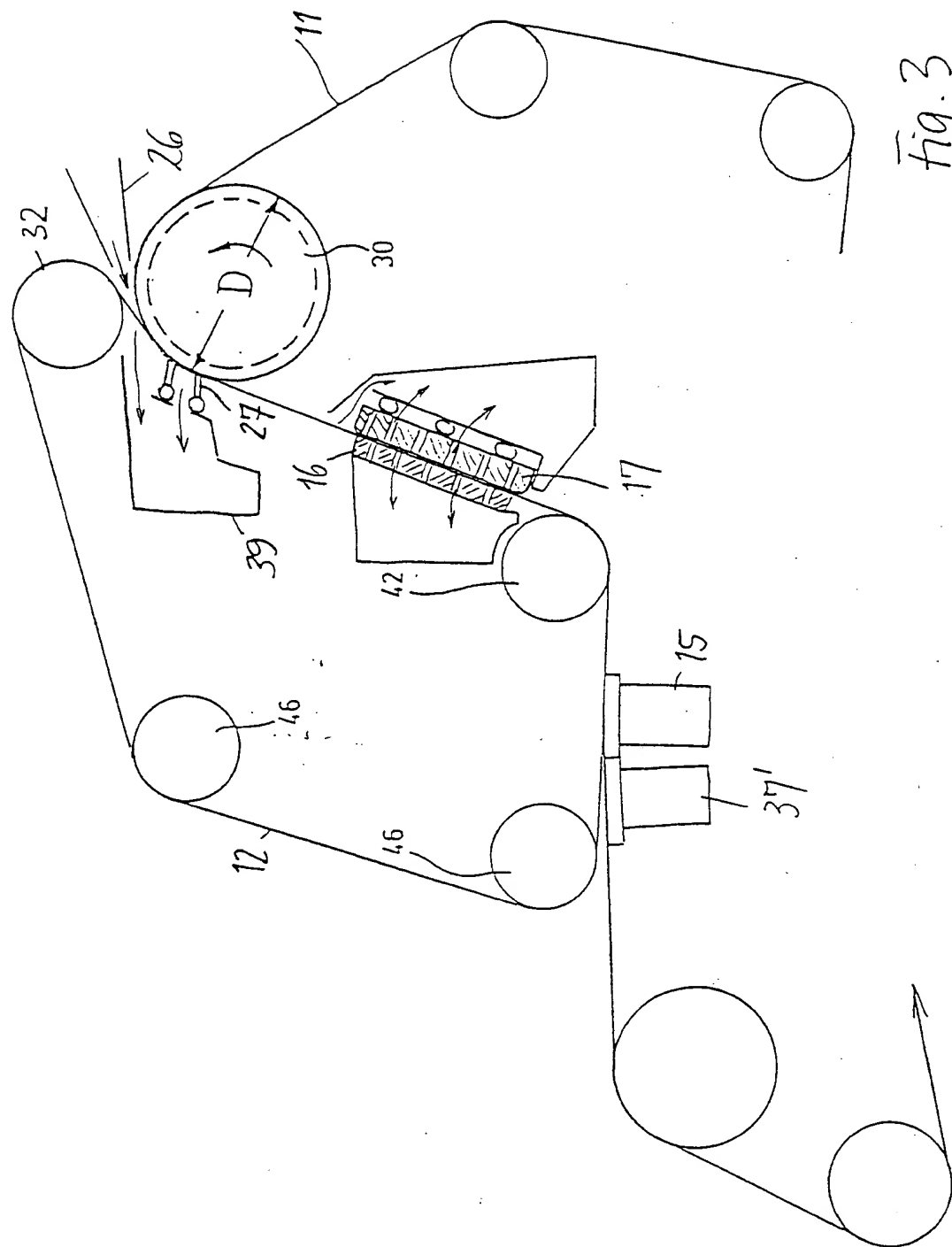


Fig. 3

Fig. 4

